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Debt enforcement, investment, and risk taking across countries☆

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ABSTRACT

We argue that the prospect of an imperfect enforcement of debt contracts in default reduces shareholder–debtholder conflicts and induces leveraged firms to invest more and take on less risk as they approach financial distress. To test these predictions, we use a large panel of firms in 41 countries with heterogeneous debt enforcement characteristics. Consistent with our model, we find that the relation between debt enforcement and firms' investment and risk depends on the firm-specific probability of default. A differences-in-differences analysis of firms' investment and risk taking in response to bankruptcy reforms that make debt more renegotiable confirms the cross-country evidence.

1. Introduction

A central result in corporate finance is that, as firms approach financial distress, key corporate decisions such as investment and risk taking get distorted by conflicts of interests between shareholders and creditors. Notably, the expectation of a low shareholder recovery in distress may lead shareholders in financially distressed firms to reject positive net present value (NPV) projects or to sell assets in place—the underinvestment effect of Myers (1977)—and

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to take on too much risk—the risk-shifting effect of Jensen and Meckling (1976).

The goal of this paper is to examine whether the enforcement of debt contracts in default affects the underinvestment and risk-shifting distortions caused by risky debt and shareholder–debtholder conflicts. To obtain empirical predictions relating debt enforcement to investment and risk choices, we develop a simple model of endogenous investment, asset sales, and risk taking in which debt enforcement affects the payoff to shareholders in default and, hence, corporate decisions close to default. The model synthesizes the theories of underinvestment (Myers, 1977), risk-shifting (Jensen and Meckling, 1976), and debt enforcement in default (Fan and Sundaresan, 2000). In the model, a firm operates risky assets and has risky, long-term debt outstanding. Management maximizes shareholder value and can make three decisions. First, it can invest in new assets. Second, it can reduce the scale of the firm by selling part of its assets before debt maturity. Third, it can change the risk of assets in place.

Using this model, we show that bankruptcy codes that favor debt enforcement decrease shareholders' expected recovery in default and, hence, the benefits of investment to shareholders. This mechanism implies that the distortions in investment and asset sales due to risky debt increase with debt enforcement in default and leads to the prediction that the effects of the default probability on investment decisions should be higher in countries with stricter debt enforcement. Additionally, we show that the prospect of a strict enforcement of debt contracts in default increases the convexity of shareholders' claim by decreasing their expected payoff in default. This leads to the prediction that the sensitivity of risk taking to the probability of default increases in countries with stricter debt enforcement.

We test these predictions using a panel of 18,602 firms in 41 countries with heterogeneous bankruptcy procedures, exploiting the cross-country variation in debt enforcement documented in the survey by Djankov, Hart, McLiesh, and Shleifer (DHMS, 2008). This survey shows that bankruptcy procedures vary substantially across countries and that an important source of heterogeneity is the amount of provisions for debt enforcement in default. In our empirical analysis, we construct a debt enforcement index with information from the DHMS survey and use this index to measure international variation in debt enforcement and shareholders' expected recovery in default. Because distortions in corporate policies are more likely when firms approach financial distress, our tests relate investment and risk to the interaction between the index of debt enforcement and firm-specific measures of default risk.

Our empirical analysis delivers three main results. First, distressed firms in countries with strict debt enforcement invest less than equally distressed firms in countries with weaker debt enforcement procedures. Notably, firms with a default probability higher than the third quartile breakpoint in countries where debt contracts are most likely to be enforced (where the *Debt enforcement* index has the maximum value of one) have an investment-to-assets ratio that is about 14% lower than similar firms in countries where debt contracts are least likely to be enforced (where the *Debt enforcement* index equals zero). Second, distressed firms' assets grow significantly less in countries where debt contracts are strictly enforced. On average, their asset growth rate is 79% smaller than that of distressed firms in a country with the weakest debt enforcement. Finally, distressed firms in countries where debt enforcement is strict are about 37% riskier, measured by total equity volatility, than similar firms in countries where debt enforcement is weaker.

The main challenge of our empirical analysis is that firms are not randomly assigned to different bankruptcy procedures. The utmost concern is that a country's bankruptcy procedure may be correlated with observable and unobservable country characteristics that are likely to affect firms' ability to invest or undertake risk through channels other than the enforceability of debt contracts. Our empirical framework attempts to control for such confounding effects by including time-varying firm and country characteristics, as well as country or firm fixed effects. The inclusion of country or firm fixed effects mitigates the concern that other unobserved country-specific factors may correlate with creditors' ability to enforce debt contracts. In addition, since firms close to distress are those that are most likely to be influenced by the bankruptcy procedures, our tests are conducted by exploiting firms' heterogeneity in their probability of facing financial distress.

To strengthen the interpretation of the results, we also implement a differences-in-differences analysis around two sets of bankruptcy reforms that targeted the renegotiability of debt and, therefore, debt enforcement. The goal of this analysis is to validate our cross-country results in a setting that, by design, reduces the concern that our results may be driven by potential effects of unobserved country characteristics. In a first step, we explore the effects of three major bankruptcy reforms in France, Italy, and Brazil in 2005 that made debtor-initiated renegotiations easier (see Weber, 2005; Rodano, Serrano Velarde, and Tarantino, 2016; Alencar and Ponticelli, 2016). In a second step, we focus on the 1978 U.S. Bankruptcy Reform Act, which had a major impact on distressed reorganizations under Chapter 11. This reform was designed to encourage debt renegotiation, by shifting bargaining power in reorganizations toward shareholders (see Hackbarth, Haselman, and Schoenherr, 2015). In all cases, we compare investment, asset growth, and risk of firms with a high default probability around each bankruptcy reform to firms with a low default probability. Consistent with the cross-country evidence, we find that high default probability firms invest relatively more and take on relatively less risk after the implementation of a reform than low default probability firms.

Our paper contributes to the literature on the real effects of debt enforcement. A recent strand of this literature shows that bankruptcy codes with fewer renegotiation frictions lead to larger debt reductions and reduce equity risk (see Fan and Sundaresan, 2000; François and Morellec, 2004; or Davydenko and Strebulaev, 2007). Consistent with this view, deviations from absolute priority caused by debtor-friendly bankruptcy codes have been shown to have important effects on equity returns both in the U.S. (see

Garlappi, Shu, and Yan, 2008; Garlappi and Yan, 2011; and Hackbarth, Haselman, and Schoenherr, 2015) and outside the U.S. (see Favara, Schroth, and Valta, 2012). While these studies assume that asset risk is given and independent of claimholders' expected recovery in default, we show that the prospect of an imperfect enforcement of debt contracts in default *reduces* asset risk. Therefore, our analysis suggests that the equity risk effects found in prior studies may not only be due to a leverage (i.e., capital structure) effect but also due to a risk-shifting effect.

Our paper also relates to the literature on agency conflicts and risk-shifting [see, for example, the recent empirical studies by Eisdorfer (2008), Gormley and Matsa (2011), Landier, Sraer, and Thesmar (2015)]. While risk-shifting incentives increase with the probability of distress, this literature has so far ignored the effects of bankruptcy law on risk taking. The paper closest to ours in this literature is Becker and Stromberg (2012). Becker and Stromberg show that a strengthening of managerial fiduciary duties to creditors mitigates underinvestment and risk-shifting incentives for firms near insolvency. Our study shows that underinvestment and risk-shifting distortions are also mitigated if debt enforcement is imperfect and shareholders expect a higher recovery on the assets in default. Because weaker debt enforcement in default in fact may increase the payoffs to both shareholders and creditors by reducing default costs [as shown, for example, in Fan and Sundaresan (2000)], the findings in these two studies suggest that legal institutions can improve overall welfare near default by aligning shareholders' incentives with creditors' interests.

A parallel literature studies the role of private arrangements to mitigate reorganization or liquidation biases of bankruptcy laws. For example, Gennaioli and Rossi (2013) argue that, when creditor protection is high, efficient resolutions of financial distress can be achieved by writing private contracts that allocate control rights to shareholders and creditors over reorganization and liquidation decisions. Our results suggest that even if such private arrangements exist, they cannot offset completely bankruptcy codes' distortions, which is consistent with the evidence in Lerner and Schoar (2005) that contractual provisions provide only a partial solution to legal enforcement problems. Even so, our analysis does not rely on the assumption that debtors and creditors cannot write state-contingent contracts. It only requires that some contracting frictions prevent parties to write contracts that Pareto improve their welfare, for example, because such contracts cannot be perfectly enforced in court.

Our paper also contributes to the large empirical literature that studies the impact of creditor rights on firms' debt capacity and investment. While there is widespread evidence that a strengthening of creditor protection improves firms' access to finance (see, e.g., La Porta, Lopez-de Silanes, and Shleifer, 2008), an improvement in creditor rights may also have adverse effects on firms. For example, Acharya, Sundaram, and John (2011) show that corporations reduce leverage in response to stronger creditor rights to avoid inefficient liquidation in bankruptcy. Acharya, Amihud, and Litov (2011) find that away from distress, firms' investment decisions may be biased toward safer projects to mitigate creditors' liquidation biases. von Lilienfeld-Toal, Mookherjee, and Visaria (2012) and Vig (2013) show that a strengthening of creditor rights may reduce debtors' welfare, even if the supply of credit increases.

The paper is organized as follows. Section 2 outlines the model and derives testable predictions. Section 3 describes the data and discusses our index of debt enforcement and the measures for investment, asset sales, and firm risk. Section 4 presents our main empirical results. Section 5 implements a difference-in-differences analysis around a few bankruptcy reforms that weaken the ability of creditors to enforce debt payments. Section 6 presents robustness tests. Section 7 concludes.

2. Theory and hypotheses

2.1. Debt enforcement, investment, and asset sales

This section presents a simple model that illustrates the effects of debt enforcement in default on shareholder–debtholder conflicts and investment and risk choices. To do so, we consider a two-period version of the Fan and Sundaresan (2000) model that we augment with investment decisions.[1] Specifically, we consider a firm with assets in place and risky debt outstanding. The value of assets at time t is denoted by V_t. The return on the firm's assets is governed by a binomial process, so that in each period the asset value can increase by a factor $z > 1$ with (risk-neutral) probability $p = \frac{1-z^{-1}}{z-z^{-1}}$ or decrease by a factor $z^{-1} < 1$ with probability $1-p$, where we assume for simplicity that the risk-free rate is zero. In addition to its assets in place, the firm has a growth option that, if undertaken, increases asset value by a factor g from V_t to $V_t(1+g)$. The cost of investment is $I > 0$, to be paid by shareholders at time $t = 0$. The investment pays off at $t = 2$ when the asset value V_2 can take three values: z^2V_0, V_0, and $z^{-2}V_0$. These assumptions imply that the increase in firm value from investment is given by

$$\mathbb{E}[gV_2] = p^2gz^2V_0 + 2p(1-p)gV_0 + (1-p)^2gz^{-2}V_0 = gV_0, \tag{1}$$

showing that, without risky debt, it is optimal for shareholders to invest if $V_0 \geq \frac{I}{g}$.

The firm has risky debt outstanding with promised payment D at time $t = 2$. To examine the effects of risky debt and default risk on investment, we consider two alternative scenarios. In the first scenario, which we call "low leverage scenario," we assume that $D = \underline{D}$ with

$$V_0 > \underline{D} > (1+g)z^{-2}V_0,$$

so that the firm only defaults in the bottom most node of the tree, with probability $(1-p)^2$. In the second scenario, which we call "high leverage scenario," we assume that $D = \overline{D}$ with

$$z^2V_0 > \overline{D} > (1+g)V_0,$$

[1] While our results do not depend on the number of periods, we need at least two periods to have three states on the final date, allowing us to examine the effects of default risk on investment and risk choices.

so that the firm defaults in the two lowest nodes, with probability $2p(1-p)+(1-p)^2$.

Suppose first that creditor rights are perfectly enforced in default so that debtholders get all of the firm's assets in default. In the high leverage scenario, the default probability is $2p(1-p)+(1-p)^2$ and shareholders invest if $gp^2z^2V_0 > I$ or if

$$V_0 \geq \overline{V} \equiv \frac{I}{gp^2z^2} = \left(\frac{z-z^{-1}}{z-1}\right)^2 \frac{I}{g} > \frac{I}{g}.$$

In the low leverage scenario, the default probability is $(1-p)^2$ and shareholders invest if

$$V_0 \geq \underline{V} \equiv \frac{I}{g[p^2z^2+2p(1-p)]} = \frac{I}{g\left[1-(1-p)^2z^{-2}\right]} > \frac{I}{g}.$$

Since $p \in (0, 1)$ and $z > 1$, we have $\overline{V} > \underline{V} > \frac{I}{g}$. It follows that with risky debt and perfect enforcement of debt obligations in default there is underinvestment, as shareholders do not invest when either $V_0 \in [I/g, \underline{V})$ (in the low leverage scenario) or $V_0 \in \left[I/g, \overline{V}\right)$ (in the high leverage scenario). Indeed, in such instances, the NPV of the growth option is less than the potential wealth transfer to debtholders.[2] In addition, underinvestment increases with the probability of default, as shown by the ordering of the investment thresholds.

Suppose now that debt can be renegotiated in default due to imperfect debt enforcement and that shareholders can appropriate a fraction $1-\eta$ of firm value, where $\eta \in [0, 1]$ captures debt enforcement in default. When $\eta = 1$, creditor rights are perfectly enforced implying that shareholders get nothing in default. When $\eta < 1$, debt enforcement is imperfect, leading to a positive payoff to shareholders in default. We show below that variation in debt enforcement should lead to variation in investment and risk taking.

To see this, note that in the high leverage scenario, the probability of default is again $2p(1-p)+(1-p)^2$ but shareholders invest if

$$V_0 \geq \overline{V}_R(\eta) \equiv \frac{I}{g\left[p^2z^2+2p(1-p)(1-\eta)+(1-p)^2(1-\eta)z^{-2}\right]}. \quad (2)$$

In the low leverage scenario, the default probability is again $(1-p)^2$ but shareholders invest if

$$V_0 \geq \underline{V}_R(\eta) \equiv \frac{I}{g\left[p^2z^2+2p(1-p)+(1-p)^2(1-\eta)z^{-2}\right]}. \quad (3)$$

Eqs. (2) and (3) show that shareholders' investment behavior reflects their expected recovery in default, which depends on debt enforcement. Because $\eta \in [0, 1]$ and $z > 1$, we have $\frac{I}{g} \leq \underline{V}_R(\eta) \leq \overline{V}_R(\eta)$, with strict inequalities when $\eta < 1$. That is, shareholders' incentives to invest decrease with the probability of default, as shareholders do not invest when either $V_0 \in [I/g, \underline{V}_R(\eta))$ (in the low leverage scenario) or $V_0 \in \left[I/g, \overline{V}_R(\eta)\right)$ (in the high leverage scenario). Eqs. (2) and (3) also show that we have $\underline{V}_R(\eta) < \underline{V}$ and $\overline{V}_R(\eta) < \overline{V}$ when $\eta < 1$ so that imperfect debt enforcement mitigates underinvestment incentives. Lastly, when $\eta = 0$, we have $\underline{V}_R(0) = \overline{V}_R(0) = \frac{I}{g}$ so that there is no underinvestment. Our model therefore reproduces Myers's (1977) main result that firms may reject positive NPV projects whenever some of the benefits of new investment accrue to debtholders by increasing the value of risky debt. Specifically, for underinvestment to arise, we need the default probability to be positive (necessary condition) and the wealth transfer to debtholders to increase the project's NPV (sufficient condition). The latter condition is satisfied if $V_0 < \underline{V}_R(\eta)$ in the low leverage scenario and if $V_0 < \overline{V}_R(\eta)$ in the high leverage scenario. Our model adds, however, to Myers' predictions by showing that underinvestment distortions are mitigated when debt enforcement in default is imperfect.

Importantly, simple calculations also show that:

$$\frac{\partial(\overline{V}_R(\eta)/\underline{V}_R(\eta))}{\partial\eta} = \frac{2z(1+z)^2}{((1+z)^2-(1+2z)\eta)^2} > 0$$

$$\frac{\partial((I/(g(1-\eta))/\underline{V}_R(\eta))}{\partial\eta} = \frac{z(z+2)}{(1+z)^2(1-\eta)^2} > 0$$

$$\frac{\partial((I/(g(1-\eta))/\overline{V}_R(\eta))}{\partial\eta} = \frac{z^2}{(1+z)^2(1-\eta)^2} > 0$$

where $I/(g(1-\eta))$ is the investment threshold when the firm defaults with probability 1 at time $t = 2$ and the ratio $\overline{V}_R(\eta)/\underline{V}_R(\eta)$ measures the change in the investment threshold due to a change in the default probability when moving from the low leverage scenario to the high leverage scenario for a given η. These relations imply that the effect of the firm-specific default probability on investment incentives increases with the degree of debt enforcement. When there is no default risk, shareholders invest if $V_0 \geq \frac{I}{g}$ and debt enforcement has no bearing on investment.[3]

Summarizing, our simple model shows that (1) firms with a positive default probability may reject positive NPV projects; (2) the effect of the default probability on investment incentives increases with debt enforcement; (3) debt enforcement does not affect investment for firms with zero default probability.

So far, we have examined the effects of debt enforcement on shareholders' incentives to acquire new assets.

[2] To see why, suppose we are in the low leverage scenario and $V_0 = \frac{I}{g}$. In this case, the NPV of the project to the firm is zero but debt value increases by $(1-p)^2gz^{-2}V_0$ following investment, implying that the wealth of shareholders decreases by the same amount if the firm invests. When $V_0 \in [I/g, \underline{V})$, the NPV of investment is positive for the firm but negative for shareholders. When $V_0 = \underline{V}$, the NPV of investment is positive for the firm and zero for shareholders. When $V_0 > \underline{V}$, the NPV of investment is positive for the firm and shareholders.

[3] When measuring the effect of debt enforcement on the relation between investment incentives and the default probability starting from a scenario in which debt is risk-free, we also have

$$\frac{\partial(\underline{V}_R(\eta)/(I/g))}{\partial\eta} > 0, \quad \frac{\partial(\overline{V}_R(\eta)/(I/g))}{\partial\eta} > 0$$

$$\text{and} \quad \frac{\partial((I/(g(1-\eta))/(I/g))}{\partial\eta} > 0,$$

showing here again that the effect of the firm-specific default probability on investment incentives increases with the degree of debt enforcement.

Debt enforcement is also important for asset sales. Suppose indeed that the firm can sell a fraction θ of its assets at time $t=0$ for a price S and that $D=\underline{D}$ (similar arguments can be made if $D=\overline{D}$). The firm will sell the asset if $S>\underline{S}(\eta)$ where

$$\underline{S}(\eta)\equiv\theta\{p^2\left[(1+g)z^2V_0-\underline{D}\right]+2p(1-p)[(1+g)V_0-\underline{D}]+(1-p)^2(1-\eta)(1+g)z^{-2}V_0\},$$

where the right-hand side of this equation represents a fraction θ of the cash flows accruing to shareholders. It is immediate to see that the minimum price $\underline{S}(\eta)$ that leads the firm to sell its assets decreases with debt enforcement and with the default probability. That is, shareholders' incentives to sell assets are distorted by risky debt because of the value that is transferred to debtholders when the firm is in default. This is another form of underinvestment.

2.2. Debt enforcement and risk-shifting

Suppose now that shareholders can increase risk just after investing in the project, i.e., engage in asset substitution.[4] When leverage is low and debt enforcement in default is imperfect, equity value just after investment is given by:

$$E(V_0;\underline{D})=p^2\left[(1+g)z^2V_0-\underline{D}\right]+2p(1-p)[(1+g)V_0-\underline{D}]+(1-p)^2(1-\eta)(1+g)z^{-2}V_0.$$

An increase in z corresponds to an increase in the possible spread of values for the project and, therefore, in project risk. Using the definition of the risk-neutral probability of an increase in asset value, we have that:

$$\frac{\partial E(V_0;\underline{D})}{\partial z}=\frac{2[\underline{D}z+\eta(1+g)V_0]}{(1+z)^3}>0, \tag{4}$$

in the low leverage case so that:

$$\frac{\partial^2 E(V_0;\underline{D})}{\partial z\partial\eta}=\frac{2(1+g)V_0}{(1+z)^3}>0. \tag{5}$$

Eq. (4) shows that, for firms with a positive default probability, shareholders have incentives to increase risk after debt has been issued, a result first uncovered by Jensen and Meckling (1976). This is due to the fact that shareholders own an option to default and that the value of this option increases with asset risk. Eq. (5) shows that by decreasing shareholders' expected recovery in default, stronger debt enforcement increases the convexity of the option payoff and makes it more attractive for shareholders to increase risk. Lastly, simple calculations also show that we have

$$\frac{\partial^2 E(V_0;\overline{D})}{\partial z\partial\eta}=\frac{2(1+g)zV_0}{(1+z)^3}>0,$$

in the high leverage case so that

$$\frac{\frac{\partial^2 E(V_0;\overline{D})}{\partial z\partial\eta}}{\frac{\partial^2 E(V_0;\underline{D})}{\partial z\partial\eta}}=\frac{\frac{2(1+g)zV_0}{(1+z)^3}}{\frac{2(1+g)V_0}{(1+z)^3}}=z>1.$$

[4] Risk-shifting can also be analyzed in closed-form in the case of a firm without a growth option, with the same results and empirical implications. See Appendix C for details.

That is, debt enforcement has a greater effect on risk taking when default risk is larger. Lastly, when D is low enough that there is no default risk, equity value after investment is given by $E(V_0;D)=(1+g)V_0-D$ and debt enforcement has no effect on risk taking.

Before turning to the empirical analysis, we summarize below our testable hypotheses:

Hypothesis 1. *Investment in leveraged firms subject to default risk should decrease with the firm-specific default probability. The effect of the default probability on investment should be stronger in countries with stricter debt enforcement.*

Hypothesis 2. *Risk in leveraged firms subject to default risk should increase with the firm-specific default probability. The effect of the default probability on risk should be stronger in countries with stricter debt enforcement.*

3. Data and empirical method

3.1. Data

Our sample covers 41 countries for the period 2000–2010. We collect accounting data in U.S. Dollars from Worldscope and Capital IQ, and stock price data in U.S. Dollars from the Center for Research in Security Prices (CRSP) (for U.S. firms) and Datastream (for the rest of the world). We exclude financial services firms (first Standard Industry Classification (SIC) code digit equal to six), utility firms (first two SIC code digits equal to 49), and government-related firms (first SIC code digit equal to 9). We winsorize the variables in our sample at the 1st and 99th percentiles to minimize the effects of outliers or coding errors in Worldscope, Capital IQ, and Datastream. The final sample consists of 18,602 firms.

Data about debt enforcement come from Djankov, Hart, McLiesh, and Shleifer (DHMS, 2008). Other country-specific variables are from the World Bank databases. Appendix A provides a description of the data collection. Table 1 contains the definitions of the variables in the data set.

3.1.1. Debt enforcement

In the model, a high value of η reflects a stricter enforcement of debt contracts via provisions in the bankruptcy procedure that make a successful debt renegotiation in or out-of-court less likely. We measure debt enforcement using the data from the DHMS international survey on debt enforcement procedures. In this survey, attorneys and judges who practice bankruptcy law in 88 countries are asked to describe how an identical case of a firm defaulting on its debt is treated. Based on these responses, DHMS report country-specific measures of the quality of debt enforcement, some of which form the basis of our analysis.

Specifically, we follow Favara, Schroth, and Valta (2012) and define *Debt enforcement* as the average of 16 binary indicators (zero if no, one if yes) that are likely to strengthen the enforcement of debt contracts in default, mainly via frictions against renegotiations. These indicators

Table 1
Definitions of variables.

Variable name	Variable definition	Source
Investment	Capital expenditures in year t/Total assets in year $t-1$	Worldscope
Asset growth	Growth in total assets from year $t-1$ to year t	Worldscope
Equity vol	Annualized standard deviation of weekly stock returns (Friday-to-Friday) in year t, as in Bartram, Brown, and Stulz (2012)	Worldscope/ Datastream
Idiosyncratic vol	Annualized standard deviation of the residuals from the regression of the firm's weekly stock returns in year t on the world market index (lag, lead, and contemporaneous)	Worldscope/Datastream
EBITDA-to-assets vol	Standard deviation of the ratio of EBITDA to assets between the years $t-7$ and t, as in John, Litov, and Yeung (2008)	Worldscope
Default probability (DP)	Default probability estimate, using Bharath and Shumway's 2008 approximation of the Merton Distance-to-Default (DD) model	Worldscope/ Datastream
Asset vol	Average of equity and debt yearly volatilities (% per year) from weekly stock prices, weighted by debt face values and market equity values, as in Bharath and Shumway (2008)	Worldscope/ Datastream
Debt enforcement (η)	Index of debt enforcement in default, constructed using the survey data in Djankov, Hart, McLiesh, and Shleifer (2008)	Djankov, Hart, McLiesh, and Shleifer (2008)
Leverage	Total debt/Total assets	Worldscope
Long-term debt	Long-term debt/ Total debt	Capital IQ
Market-to-book ratio	(Total assets + market cap - book equity)/Total assets	Worldscope
Cash flow-to-assets	(Net income + Depreciation & amortization)/Total assets	Worldscope
EBITDA-to-assets	Ratio of EBITDA to total assets	Worldscope
log(Total assets)	Logarithm of total assets	Worldscope
log(GDP per capita)	Logarithm of gross national income per capita	World Bank
GDP growth	Annual gross domestic product growth	World Bank
Stockmarket cap to GDP	Ratio of the country's total stock market capitalization to the total gross national income	World Bank
Creditor rights	La Porta, Lopez-de Silanes, Shleifer, and Vishny's (1998) country-specific index of creditors' rights; ranges from 0 to 4	La Porta, Lopez-de Silanes, Shleifer, and Vishny (1998)

include the rights of creditors to seize and sell firm collateral without court approval; to enforce their claims in an out-of-court procedure; to approve the appointment of an insolvency administrator and dismiss it; and to vote directly on the reorganization plan of a defaulting firm. The index also includes information on whether an insolvency procedure cannot be appealed and whether management is automatically dismissed during the resolution of the insolvency procedure. As a result, this index captures impediments to shareholders' ability to renege on outstanding debt, whether through a formal insolvency procedure or outside of court. By construction, the *Debt enforcement* index ranges from zero to one: the higher the score, the stricter debt enforcement and the less likely shareholders will be able to renegotiate debt in default. A detailed description of this index is provided in Appendix B.1.

As in Favara, Schroth, and Valta (2012), we impute the DHMS survey results from 2005 to all the years in our sample (2000–2010), assuming that the survey captures the essence of each country's approach to insolvency, which is deeply rooted in persistent economical, political, and societal values. We explore the validity of this assumption in Section 5, where we track all major changes to each country's bankruptcy code in our sample period. While such changes are rare, we conduct in Section 5 a difference-in-differences analysis of firms' behavior around the few cases where the country's bankruptcy code reform changes debt enforcement by making it easier to renegotiate debt.[5]

Table 2 shows that the average value of the *Debt enforcement* index in our sample is 0.54, with a standard deviation of 0.25. The majority of countries in the sample are concentrated around values of 0.45 and 0.58, including Japan and the U.S. According to the *Debt enforcement* index, debt is expected to be enforced relatively weakly in countries with a French origin of the legal system, e.g., France, Italy, and the Netherlands. Conversely, debt enforcement is stricter in, e.g., Austria, Finland, or Hungary, as well as Thailand or Turkey. Table 2 also shows that the number of firms varies substantially across countries, with U.S. and Japanese firms respectively accounting for 16% and 12.6% of the sample observations. We show below that our results continue to hold when we exclude U.S. and Japanese firms from the sample.

3.1.2. *Default probability*

Conflicts of interest between shareholders and debtholders, and hence underinvestment and risk-shifting distortions, are most prevalent when a firm has risky debt and when there is a significant probability that the firm will default on its debt obligations. To measure the default probability, we rely on the naïve default probability measure of Bharath and Shumway (2008), which is an approximation of the Merton (1974) model.[6] Bharath and

[5] Bankruptcy law reforms until 2004 are tracked by Djankov, McLiesh, and Shleifer (2007), and by the World Bank (www.doingbusiness.org). Within our 10-year sample period, the only major changes in the bankruptcy code that explicitly affected the renegotiability of debt are in France (2005), Brazil (2005), and Italy (2005). Major bankruptcy reforms in Russia (2004) and Spain (2004) are not focused on debt renegotiability. Japan also changed its bankruptcy code in 2000, but the changes were undone in 2002.

[6] The naïve default probability approximates the functional form of the Merton default probability, but simplifies the computation of the variables needed as inputs. The two main simplifications are: 1) the expected return on the firm's assets is measured by the firm's stock return over the previous year; 2) total asset volatility is measured as a weighted average of the book debt and market equity volatilities. See Bharath and Shumway(2008, p. 1347) for further details.

Table 2
Descriptive statistics by country.
This table presents a within-country summary (number of firms per country, N; mean; and standard deviation, sd) of *Debt enforcement, Default probability (DP), Investment, Asset growth*, and *Equity returns vol*. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). Please refer to Table 1 for a definition of these variables.

Country	*Debt enforcement*		*Default probability*		*Investment*		*Asset growth*		*Equity vol*		*Idiosyncratic vol*	
	N	Mean	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Argentina	58	0.308	0.346	0.359	0.053	0.059	0.025	0.245	0.471	0.289	0.453	0.291
Australia	657	1.000	0.285	0.333	0.072	0.095	0.147	0.341	0.586	0.349	0.535	0.335
Austria	60	0.667	0.332	0.344	0.071	0.060	0.093	0.261	0.428	0.247	0.381	0.218
Belgium	87	0.615	0.349	0.361	0.072	0.077	0.084	0.230	0.404	0.261	0.356	0.256
Brazil	204	0.417	0.382	0.374	0.068	0.067	0.160	0.316	0.600	0.388	0.533	0.362
Canada	853	0.667	0.336	0.345	0.094	0.111	0.141	0.337	0.661	0.434	0.602	0.409
Chile	111	0.000	0.297	0.341	0.069	0.072	0.104	0.209	0.343	0.242	0.315	0.236
China	1,472	0.000	0.463	0.348	0.074	0.080	0.163	0.251	0.510	0.204	0.482	0.193
Denmark	101	0.500	0.334	0.349	0.070	0.078	0.086	0.261	0.426	0.235	0.381	0.217
Finland	108	0.692	0.294	0.341	0.061	0.066	0.084	0.241	0.380	0.169	0.320	0.140
France	540	0.231	0.306	0.338	0.050	0.054	0.101	0.250	0.464	0.284	0.413	0.273
Germany	576	0.455	0.338	0.348	0.055	0.061	0.076	0.257	0.471	0.261	0.428	0.249
Great Britain	961	1.000	0.308	0.344	0.052	0.064	0.089	0.305	0.471	0.275	0.428	0.266
Greece	230	0.417	0.414	0.373	0.057	0.079	0.101	0.247	0.519	0.213	0.464	0.200
Hong Kong	684	1.000	0.368	0.352	0.048	0.065	0.104	0.290	0.619	0.367	0.578	0.347
Hungary	14	0.667	0.306	0.333	0.095	0.067	0.098	0.206	0.391	0.115	0.323	0.082
India	175	0.500	0.410	0.351	0.075	0.076	0.112	0.223	0.857	0.580	0.756	0.566
Ireland	45	0.615	0.320	0.345	0.054	0.072	0.108	0.276	0.469	0.266	0.438	0.263
Israel	302	0.556	0.357	0.360	0.043	0.062	0.095	0.258	0.533	0.282	0.489	0.261
Italy	187	0.231	0.404	0.365	0.047	0.059	0.076	0.234	0.388	0.220	0.327	0.197
Japan	2,345	0.538	0.371	0.333	0.038	0.044	0.044	0.175	0.420	0.231	0.389	0.225
Malaysia	763	0.583	0.309	0.339	0.048	0.064	0.075	0.212	0.514	0.326	0.480	0.316
Mexico	84	0.273	0.381	0.371	0.051	0.048	0.065	0.211	0.417	0.268	0.349	0.244
Netherlands	114	0.250	0.373	0.347	0.055	0.056	0.102	0.262	0.426	0.240	0.358	0.225
New Zealand	79	1.000	0.265	0.330	0.076	0.078	0.151	0.325	0.373	0.181	0.338	0.185
Norway	110	0.385	0.371	0.371	0.086	0.099	0.129	0.340	0.505	0.268	0.445	0.255
Peru	81	0.538	0.276	0.349	0.064	0.077	0.129	0.263	0.448	0.337	0.444	0.335
Philippines	102	0.538	0.352	0.358	0.056	0.073	0.063	0.244	0.618	0.351	0.570	0.348
Poland	236	0.417	0.281	0.349	0.072	0.081	0.147	0.333	0.539	0.217	0.469	0.207
Portugal	45	0.538	0.417	0.358	0.053	0.055	0.108	0.248	0.387	0.258	0.348	0.255
Russia	98	0.250	0.428	0.387	0.094	0.090	0.157	0.290	0.575	0.370	0.541	0.367
Singapore	488	1.000	0.327	0.341	0.052	0.072	0.101	0.265	0.585	0.346	0.544	0.332
South Africa	229	0.455	0.313	0.351	0.079	0.075	0.154	0.318	0.559	0.381	0.487	0.348
South Korea	1,187	0.538	0.363	0.339	0.062	0.074	0.105	0.265	0.732	0.382	0.658	0.358
Spain	95	0.462	0.336	0.363	0.057	0.057	0.138	0.301	0.345	0.184	0.285	0.153
Sweden	274	0.667	0.287	0.335	0.040	0.049	0.099	0.284	0.514	0.300	0.456	0.299
Switzerland	148	0.538	0.311	0.334	0.049	0.044	0.083	0.216	0.361	0.185	0.313	0.168
Taiwan	1,139	0.538	0.377	0.346	0.055	0.067	0.078	0.214	0.479	0.193	0.439	0.184
Thailand	379	0.692	0.291	0.345	0.061	0.071	0.084	0.214	0.475	0.265	0.435	0.256
Turkey	187	0.692	0.353	0.354	0.066	0.081	0.138	0.314	0.571	0.217	0.459	0.174
USA	2,994	0.538	0.417	0.341	0.057	0.070	0.070	0.262	0.577	0.346	0.508	0.316
Total	18,602	0.536	0.365	0.344	0.058	0.069	0.095	0.255	0.531	0.295	0.473	0.295

Shumway (2008) show that the naïve default probability performs better at predicting default than the actual Merton (1974) model probability. Moreover, the naïve default probability can be easily computed for our large international panel of firms because it does not rely on credit ratings data. Table 2 shows that the default probability varies significantly within and across countries.

3.1.3. Investment, asset growth, and risk

We study the relation between the default probability, its interaction with debt enforcement, and three main outcome variables: Investment, asset sales, and risk. We measure *Investment* as capital expenditures in year t divided by total assets in year $t-1$. The average investment rate is 5.6% with a standard deviation of 0.070.

Because capital expenditures are truncated at zero, they are not informative about whether the firm is selling or buying assets. We use *Asset growth* as an alternative measure of investment because it can take negative values and, therefore, includes asset sales. We define *Asset growth* as the growth in total assets from year $t-1$ to year t. In the sample, the average asset growth rate is 9.2% with a standard deviation of 0.257.[7]

To measure risk, we use three proxies based on the market price of equity. The first risk measure, *Equity vol*, is

[7] Alternative approaches to measure asset sales in the literature include the uses of keyword searches for 'asset,' 'sale,' and 'divestiture' within 8K filings with the Securities and Exchange Commission (SEC) (Lang, Poulsen, and Stulz, 1995), reductions in the number of industry segments per firm reported in Compustat (Schlingemann, Stulz, and Walkling, 2002), divestiture data from Securities Data Company (SDC) (Schlingemann, Stulz, and Walkling, 2002) and plant-level data (Yang, 2008). The data required to implement these approaches in our international cross-section are unavailable.

equal to the annualized standard deviation of weekly stock returns (Friday-to-Friday) in year t as in Bartram, Brown, and Stulz (2012).[8] The second risk measure, *Idiosyncratic vol*, uses idiosyncratic stock return volatility. For every firm in the sample, we regress a firm's weekly stock returns in year t on the lagged, contemporaneous, and lead world market index return and compute *Idiosyncratic vol* as the annualized standard deviation of the residuals. This measure allows us to test whether shareholders control systematic or idiosyncratic equity volatility in their attempt to increase risk.[9] The third risk measure, *Asset vol*, is computed as in Bharath and Shumway (2008) as the average of the annual equity and debt volatilities, weighted by the market equity and debt face values. We also use a risk measure based on accounting information. Notably, following John, Litov, and Yeung (2008), we compute the volatility of the ratio of Earnings before interest, taxes, depreciation, and amortization (EBITDA) to assets over 8 years, between years t and $t-7$, requiring at least five available observations. While *EBITDA-to-assets vol* is a widely used measure of asset risk, it is clearly backward-looking and may not capture the risk associated with shareholders' operational or investment choices.

3.1.4. Other firm- and country-level control variables

Table 3 summarizes all the control variables used in the analysis. For the majority of the variables in the data set, the variation is mostly between rather than within firms. This feature of the data is not surprising for some variables, such as leverage, which are known to have large permanent components (Lemmon, Roberts, and Zender, 2008). Other variables, such as *Default probability* and *Asset growth*, exhibit larger within-firm variation.

3.2. Empirical method

To test our hypotheses, we estimate the following regression model:

$$\begin{aligned} \textit{Dependent variable}_{i,j,c,t} &= \beta_0 + \beta_D \times \textit{Default probability}_{i,j,c,t-1} \\ &+ \beta_\eta \times \textit{Debt enforcement}_c \\ &+ \beta_{D\eta} \times \textit{Default probability}_{i,j,c,t-1} \\ &\times \left(\textit{Debt enforcement}_c - \overline{De}\right) \\ &+ \delta_t + \boldsymbol{\beta}_{Control} \times \textbf{Controls}_{i,j,c,t-1} + u_{i,j,c,t}. \quad (6) \end{aligned}$$

In Eq. (6), the dependent variable is either *Investment*, *Asset growth*, or one of the risk measures. We use the subscripts i for firms, j for industries, c for countries, and t for years. *Default probability*$_{i,j,c,t-1}$ is the lagged default probability, *Debt enforcement*$_c$ is the country-specific measure of debt enforcement, and $\overline{De}$ is its sample mean. **Controls**$_{i,j,c,t-1}$ is a set of predetermined firm and country characteristics that are likely to affect our dependent variables. We control for firms' growth opportunities with the market-to-book ratio (*Market-to-book ratio*), for the available cash flow (*Cash flow-to-assets ratio*), for size (log(*Total assets*)), and for profitability (*EBITDA-to-assets*). We also include country-level cyclical factors influencing investment, growth opportunities, and risk, such as the log of *Gross Domestic Product (GDP) per capita, GDP growth*, and *Stockmarket cap to GDP*. We include year fixed effects (δ_t) to control for time-varying factors common to all firms. We cluster standard errors at the country level.

According to Hypotheses 1 and 2, the main parameters of interest in our empirical analysis are β_D and $\beta_{D\eta}$. The parameter β_D measures the association between the firm's default probability and the dependent variable evaluated at the sample mean of *Debt enforcement*$_c$. We expect β_D to be negative for investment and asset growth, and positive for risk. $\beta_{D\eta}$ measures, instead, how the relation between a firm's investment or risk and its default probability vary with the country-specific measure of debt enforcement. We expect this parameter to be negative for the investment and asset growth regressions and positive for the risk regressions.

Our benchmark regression model is estimated with either country and industry fixed effects or firm fixed effects. These fixed effects absorb time-invariant differences across industries and countries or firms, and minimize the concern that other unobserved factors may drive the results. For example, country fixed effects account for other time-invariant country-specific factors, such as the efficiency of the judicial system or the rule of law. Firm fixed effects mitigate the concern that unobserved firm-level attributes, provided they are time-invarying, affect the firms' default probability as well as their investment and risk decisions. Adding these fixed effects causes the country-specific *Debt enforcement*$_c$ variable to drop out. Our model predicts that this variable's coefficient, β_η, should be zero when the firm's probability of default is zero. We test this additional implication as a robustness test in a pooled Ordinary Least Squares (OLS) regression, with the caveat that the OLS estimate of β_η might also capture the effect of other unobservable country characteristics, unrelated to debt enforcement.

4. Results

4.1. Investment

Table 4 presents the main results for investment. Our main interest is on the coefficients of *Default probability* and the interaction term *Default probability* × *Debt enforcement*. Columns 1 and 2 show the estimates for our benchmark specification with industry and country, or firm fixed effects, respectively.

As predicted, both *Default probability* and its interaction with *Debt enforcement* correlate negatively and significantly

[8] Some stocks in our sample are not frequently traded. Hence, by computing returns based on weekly data, these stocks have zero returns. This computation could bias downward our volatility estimates. To address this issue, we exclude from the sample all firms with high proportions of zero stock returns. The current sample uses a cutoff of 90%, but the results are robust to lower cutoff levels. The results are also robust to using returns and volatilities based on daily stock prices.

[9] Chen, Strebulaev, Xing, and Zhang (2014) show that idiosyncratic volatility is the best predictor of future stock returns among all the components of total asset volatility. Their interpretation is that, given the choice, shareholders prefer to increase idiosyncratic rather than systematic risk because the latter reduces the stock value and the former does not carry downside market risk.

Table 3
Firm characteristics.

This table presents descriptive statistics (number of firm-year observations, N; mean; standard deviation, decomposed into between-firm, sd_b, and within-firm, sd_w, variation; and the three quartiles: p25, p50, and p75) of the variables used in the analysis. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). Please refer to Table 1 for a definition of these variables.

			Standard deviation					
	N	Mean	Total	sd_b	sd_w	p25	p50	p75
Investment	113,598	0.056	0.070	0.061	0.046	0.014	0.034	0.070
Asset growth	114,559	0.092	0.257	0.181	0.221	−0.047	0.061	0.184
Equity vol	113,950	0.518	0.307	0.288	0.204	0.316	0.441	0.625
Idiosyncratic vol	112,948	0.471	0.290	0.276	0.190	0.282	0.397	0.568
EBITDA-to-assets vol	93,671	0.063	0.060	0.066	0.025	0.025	0.043	0.077
Default probability	112,337	0.339	0.345	0.211	0.300	0.004	0.217	0.658
Asset vol	113,754	0.404	0.239	0.232	0.155	0.249	0.341	0.484
Leverage	114,559	0.257	0.180	0.170	0.088	0.111	0.239	0.371
Long-term debt	86,683	0.561	0.315	0.281	0.174	0.294	0.586	0.846
Market-to-book ratio	114,557	1.430	1.005	0.979	0.598	0.904	1.136	1.580
Cash flow-to-assets ratio	111,517	0.068	0.118	0.121	0.075	0.028	0.071	0.123
EBITDA-to-assets	112,353	0.085	0.130	0.136	0.082	0.045	0.094	0.147
log(Total assets)	114,559	5.464	1.809	1.792	0.377	4.215	5.323	6.599
log(GDP per capita)	114,062	9.812	1.093	1.061	0.225	9.033	10.380	10.583
GDP growth	114,491	0.035	0.041	0.035	0.025	0.014	0.029	0.052
Stockmarket cap to GDP	107,848	1.090	0.820	0.771	0.298	0.663	0.995	1.296
Creditor rights	114,559	2.212	1.106	1.109	0.106	1.000	2.000	3.000

Table 4
Debt enforcement and capital investment.

This table presents industry and country fixed effects (ICFE), firm fixed effects (FFE), OLS, and fifth-order linear cumulant (LC5) estimates of investment regressions. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). The dependent variable is yearly *Investment*. All specifications include year fixed effects. The coefficient on *Default probability* reports the conditional correlation between *Investment* and *Default probability* evaluated at the sample mean of *Debt enforcement*. Standard errors (in parentheses under each estimate) are clustered by country. The ρ^2 statistic is the coefficient of determination for the LC5 estimator, excluding the variation determined by country and industry fixed effects. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Specification	(1) ICFE	(2) FFE	(3) OLS	(4) LC5
Default probability (DP)	−0.003**	−0.007***	0.000	−0.005***
	(0.002)	(0.002)	(0.002)	(0.001)
DP × *Debt enforcement*	−0.008**	−0.008**	−0.011**	−0.010***
	(0.004)	(0.004)	(0.005)	(0.003)
Debt enforcement (η)			0.005	
			(0.006)	
Market-to-book ratio	0.007***	0.008***	0.007***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Cash flow-to-assets	0.172***	0.094***	0.202***	0.006
	(0.021)	(0.015)	(0.022)	(0.011)
EBITDA-to-assets	−0.045***	−0.016*	−0.049***	0.111***
	(0.009)	(0.010)	(0.014)	(0.010)
log(Total assets)	−0.001***	−0.019***	0.000	0.001
	(0.000)	(0.002)	(0.000)	(0.000)
GDP growth	0.044	0.024	0.121***	0.050***
	(0.028)	(0.033)	(0.041)	(0.015)
log(GDP per capita)	−0.000	0.006	−0.002	0.002
	(0.003)	(0.005)	(0.002)	(0.374)
Stockmarket cap to GDP	0.003	0.002	−0.002	0.003***
	(0.002)	(0.002)	(0.001)	(0.001)
Observations	102,239	102,239	102,239	102,239
R^2	0.25	0.53	0.10	
ρ^2				0.06
Economic significance : $\Delta E(y) \equiv E(y\|\eta = 0, .) - E(y\|\eta = 1, .)$				
$\Delta E(Investment)$	0.007**	0.007**	0.004	0.009***
Standard error	(0.003)	(0.003)	(0.005)	(0.002)
$\frac{\Delta E(Investment)}{\text{mean } Investment}$	0.143	0.144	0.085	0.174

with investment rates.[10] To evaluate the economic significance of our estimates, we compute the implied difference between the expected investment rates of firms that are similar, given our control variables, but operate in countries with different values of the *Debt enforcement* index. We evaluate the statistic

$$\begin{aligned}\Delta E(Investment) \equiv\ & E(Investment|\eta_0, .) \\ & -E(Investment|\eta_1, .) \\ =\ & \hat{\beta}_\eta \times (\eta_0 - \eta_1) \\ & +\hat{\beta}_{D\eta} \times (Default\ probability_0 \times \eta_0 \\ & -Default\ probability_1 \times \eta_1). \qquad (7)\end{aligned}$$

In this equation, η_0 and η_1 are any two given values of the *Debt enforcement* index. *Default probability*$_i$ is the average default probability for all firms with a default probability higher than the third quartile breakpoint in countries where $\eta = \eta_i$. Table 4 reports this statistic, comparing countries where debt enforcement is weakest ($\eta_0 = 0$, say China) and strongest ($\eta_1 = 1$, say Australia). Accounting for unobservable industry and country or firm fixed effects, the differences exceed 14% of the average investment ratio.[11]

Column 3 reports the results of a pooled OLS regression. This regression allows us to measure the correlation between *Debt enforcement* and investment when the probability of default is zero. As shown, *Debt enforcement* does not correlate with investment directly, but only via its interaction with *Default probability*. This finding reassures us that our index of debt enforcement does not proxy for other country characteristics that affect investment and are unrelated to shareholders' expected recovery in default. If this were the case, *Debt enforcement* could also be correlated with investment unconditionally of firms' default probabilities.

Lastly, Erickson and Whited (2000) show that the error in the market-to-book ratio ('average *Q*') as a proxy for marginal *q* may bias the estimates in the investment regressions. Following Erickson, Jiang, and Whited (2014), we use the fifth-order linear cumulants estimator assuming measurement error in *Market-to-book ratio* and *Cash flow-to-assets*. Column 4 shows that our results are robust to this correction.[12]

Overall, the results in Table 4 show that, even after controlling for observable firm and country characteristics and for unobservable fixed differences in investment across industries, countries, and firms, investment ratios among the relatively more distressed firms are significantly lower in countries where the bankruptcy procedure favors strict debt enforcement.

Becker and Stromberg (2012) estimate that a 1991 Delaware bankruptcy ruling, which established stronger managerial fiduciary duties toward creditors, increased investment for firms close to insolvency. They interpret this finding as evidence that a transfer of control rights from debtors to creditors mitigates the distortions due to debt overhang. Our results suggest that *increasing* shareholders' expected recovery in default may also mitigate the distortions caused by risky debt. Because imperfect debt enforcement in default in fact may increase the cash flow to both shareholders and creditors by reducing default costs,[13] the findings in these two studies suggest that legal institutions can improve efficiency near default by aligning shareholders' incentives with creditors' interests.

4.2. Asset growth

We use asset growth as an alternative measure of investment that is also indicative of asset sales, and estimate the same specifications as before, but with *Asset growth* as a dependent variable. Table 5 presents the results.

Columns 1 and 2 show that *Asset growth* and *Default probability* are on average negatively correlated across countries. Moreover, asset growth is significantly lower for distressed firms in countries with stricter debt enforcement. Column 3 reports the same results for the pooled OLS regression. Column 4 corrects for measurement error in *Market-to-book ratio* and *Cash flow-to-assets* using a fifth-order cumulants estimator. In all columns, the coefficients of *Default probability* and of the interaction term *Default probability* × *Debt enforcement* are negative and statistically significant, with the exception of *Default probability*in columns 2 and 4.

Economically, the asset growth rate differences between firms in countries with strongest versus weakest debt enforcement vary between 43% and 89% of the average asset growth rate across all countries. Our estimates also suggest that *Debt enforcement* is associated with *Asset growth* only through its interaction with the default probability—the OLS estimate of β_η is not significantly different from zero in column 3. Overall, the results in Table 5 provide support for our hypothesis on the effects of debt enforcement on firms' investment decisions.

4.3. Risk

Table 6 shows the estimates of the risk specification using our four different proxies for risk. In Panel A, columns 1–3 show the results for *Equity vol*, and columns 4–6 for *Idiosyncratic vol.* In Panel B, columns 1–3 report the results for total *Asset vol*, and columns 4–6 for *EBITDA-to-*

[10] The coefficients of the control variables have the expected sign. While predetermined, some of the control variables used in all our specifications are endogenous, though standard in the corporate finance and investment literature. The estimated coefficient of the interaction between *Default probability* and *Debt enforcement* actually *increases* if we exclude these control variables (not reported).

[11] The stability of the interaction effects in columns 1 and 2 suggests that unobservable factors correlated with country or firm fixed effects are unlikely to bias our results.

[12] Our results are also robust up to the eighth-order estimator, or to allowing for measurement error in average *Q* (*Market-to-book*), profitability (*EBITDA-to-assets*), and the probability of default (*DP*).

[13] Fan and Sundaresan (2000), François and Morellec (2004), and Davydenko and Strebulaev (2007) show, for example, that this is the case if liquidation entails costs, and an imperfect enforcement of debt contracts allows the firm to avoid costly liquidation. There exists a large empirical literature documenting significant liquidation costs both in the U.S. (see, e.g., Warner, 1977; Andrade and Kaplan, 1998; Davydenko, Strebulaev, and Zhao, 2012; or Glover, 2016) and outside the U.S. (see, e.g., Gungoraydinoglu and Oztekin, 2011).

Table 5
Debt enforcement and asset growth.
This table presents industry and country fixed effects (ICFE), firm fixed effects (FFE), OLS, and fifth-order linear cumulant (LC5) estimates of asset growth regressions. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000–2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). The dependent variable is *Asset growth*. All specifications include year fixed effects. The coefficient on *Default probability* reports the conditional correlation between *Asset growth* and *Default probability* evaluated at the sample mean of *Debt enforcement*. Standard errors (in parentheses under each estimate) are clustered by country. The ρ^2 statistic is the coefficient of determination for the LC5 estimator, excluding the variation determined by country and industry fixed effects. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Specification	(1) ICFE	(2) FFE	(3) OLS	(4) LC5
Default probability (DP)	−0.036**	−0.013	−0.042**	0.007**
	(0.014)	(0.014)	(0.017)	(0.003)
DP × Debt enforcement	−0.057**	−0.054**	−0.051*	−0.064***
	(0.026)	(0.028)	(0.027)	(0.011)
Debt enforcement (η)			0.017	
			(0.019)	
Market-to-book ratio	0.043***	0.048***	0.041***	0.152***
	(0.005)	(0.009)	(0.004)	(0.004)
Cash flow-to-assets	0.393***	0.240***	0.409***	0.378***
	(0.044)	(0.039)	(0.042)	(0.072)
EBITDA-to-assets	−0.002	0.114***	−0.011	−0.086
	(0.025)	(0.029)	(0.032)	(0.061)
log(Total assets)	−0.006***	−0.217***	−0.004**	−0.001
	(0.001)	(0.016)	(0.002)	(0.001)
GDP growth	0.782***	0.575**	0.786***	0.963***
	(0.262)	(0.244)	(0.145)	(0.060)
log(GDP per capita)	0.070***	0.187***	0.003	0.036***
	(0.017)	(0.040)	(0.006)	(0.007)
Stockmarket cap to GDP	0.035***	0.031**	0.004	0.025***
	(0.010)	(0.013)	(0.004)	(0.004)
Observations	103,028	103,028	103,028	103,028
R^2	0.15	0.41	0.13	
ρ^2				0.14
Economic significance : $\Delta E(y) \equiv E(y\|\eta = 0, .) - E(y\|\eta = 1, .)$				
$\Delta E(\textit{Asset growth})$	0.049**	0.046*	0.027	0.055***
Standard error	(0.022)	(0.024)	(0.019)	(0.010)
$\frac{\Delta E(\textit{Asset growth})}{\text{mean } \textit{Asset growth}}$	0.787	0.754	0.433	0.888

assets vol. Across all our specifications, we find that *Default probability* and the interaction between *Default probability* and *Debt enforcement* have a positive coefficient, irrespective of the risk proxy. Except for the specification in column 4 of Panel B, the estimates are all statistically significant. As with investment and asset growth, our measure of debt enforcement explains a large proportion of the covariation between risk variables and the probability of default. Additionally, the OLS estimates of the correlation between risk and *Debt enforcement* when *Default probability* equals zero are not statistically different from zero for all risk variables but *EBITDA-to-assets vol*.

In terms of economic significance, the difference between the average *Equity vol* of a firm with high default probability (i.e., higher than the third quartile breakpoint of the estimation sample), in a country where the *Debt enforcement* index equals one and the *Equity vol* of a similar firm in a country where the *Debt enforcement* index equals zero ranges between 35% and 44% of the average *Equity vol*. We find similarly strong economic magnitudes for *Asset vol* and *Idiosyncratic vol*. In the following, we only report results based on *Equity vol* and *Idiosyncratic vol*. We obtain similar results when using *Asset vol* or *EBITDA-to-assets vol*.

Acharya, Amihud, and Litov (2011) find that stronger creditor rights reduce corporate risk taking by estimating the correlation between the ex ante protection of creditor rights, as measured by the index of La Porta, Lopez-de Silanes, Shleifer, and Vishny (1998), and corporate risk, as measured by firms' cash flow variability and risk-reducing investments such as diversifying acquisitions. Our findings that *Debt enforcement* increases the sensitivity of firm risk to its default probability are obtained using an index of creditor rights that reflects how the law is expected to be enforced in practice, as opposed to how it is written on the books, and proxies of firm risk based on the market price of equity. Section 6.1 discusses in more detail the difference between the two indices of creditor rights.

5. Bankruptcy code reforms

In this section, we exploit the reforms to the bankruptcy codes in different countries to compare the behavior of firms before and after such changes using a difference-in-differences analysis. First, we test our theory using the bankruptcy law changes that affected debt enforcement by easing the renegotiability of debt in our

Table 6
Debt enforcement and risk.
This table presents industry and country fixed effects (ICFE), firm fixed effects (FFE), and OLS estimates of risk regressions. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). The dependent variable is *Equity vol* in columns 1–3 of Panel A, *Idiosyncratic vol* in columns 4–6 of Panel A, total implied *Asset vol* in columns 1–3 of Panel B, and *EBITDA-to-assets vol* in columns 4–6 of Panel B. All specifications include year fixed effects. The coefficient on *Default probability* reports the conditional correlation between the dependent variable and *Default probability* evaluated at the sample mean of *Debt enforcement*. Standard errors (in parentheses under each estimate) are clustered by country. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Panel A

Dependent variable:	*Equity vol*			*Idiosyncratic vol*		
Specification	(1) ICFE	(2) FFE	(3) OLS	(4) ICFE	(5) FFE	(6) OLS
Default probability (DP)	0.219***	0.145***	0.229***	0.207***	0.136***	0.215***
	(0.019)	(0.021)	(0.024)	(0.018)	(0.018)	(0.023)
DP × Debt enforcement	0.207***	0.197***	0.246***	0.210***	0.201***	0.245***
	(0.068)	(0.068)	(0.081)	(0.067)	(0.068)	(0.083)
Debt enforcement			−0.046			−0.059
			(0.056)			(0.051)
Market-to-book ratio	0.012**	0.002	0.018*	0.009*	−0.003	0.013*
	(0.005)	(0.006)	(0.009)	(0.005)	(0.005)	(0.007)
Cash flow-to-assets	−0.185***	−0.078	−0.194***	−0.228***	−0.094**	−0.235***
	(0.041)	(0.047)	(0.051)	(0.039)	(0.042)	(0.049)
EBITDA-to-assets	−0.362***	−0.225***	−0.341***	−0.303***	−0.195***	−0.291***
	(0.038)	(0.059)	(0.050)	(0.032)	(0.052)	(0.045)
log(Total assets)	−0.052***	−0.044***	−0.050***	−0.057***	−0.056***	−0.056***
	(0.005)	(0.011)	(0.004)	(0.005)	(0.010)	(0.004)
GDP growth	0.09	0.006	0.716	0.036	−0.051	0.729*
	(0.237)	(0.281)	(0.471)	(0.245)	(0.280)	(0.388)
log(GDP per capital)	0.089***	0.056	0.003	0.091***	0.066**	−0.001
	(0.032)	(0.037)	(0.023)	(0.028)	(0.032)	(0.020)
Stockmarket cap to GDP	0.055**	0.044*	0.020	0.062***	0.049*	0.022*
	(0.021)	(0.024)	(0.014)	(0.022)	(0.025)	(0.012)
Observations	108,700	108,700	108,700	105,111	105,111	105,111
R^2	0.39	0.65	0.29	0.39	0.65	0.30
Economic significance : $\Delta E(y) \equiv E(y\|\eta = 0, .) - E(y\|\eta = 1, .)$						
ΔE(*Dependent variable*)	−0.177***	−0.168***	−0.209***	−0.179***	−0.171***	−0.209***
Standard error	(0.057)	(0.058)	(0.068)	(0.056)	(0.057)	(0.070)
$\frac{\Delta E(\textit{Dependent variable})}{\text{mean } \textit{Dependent variable}}$	−0.372	−0.353	−0.440	−0.399	−0.381	−0.466

Panel B

Dependent variable:	*Asset vol*			*EBITDA-to-assets vol*		
Specification	(1) ICFE	(2) FFE	(3) OLS	(4) ICFE	(5) FFE	(6) OLS
Default probability (DP)	0.059***	0.060***	0.066***	0.014***	0.003**	0.016***
	(0.012)	(0.013)	(0.015)	(0.002)	(0.001)	(0.002)
DP × Debt enforcement	0.095**	0.120***	0.111**	0.006	0.005*	0.011**
	(0.038)	(0.042)	(0.044)	(0.004)	(0.003)	(0.004)
Debt enforcement (η)			−0.038			0.021**
			(0.044)			(0.010)
Market-to-book ratio	0.028***	0.009*	0.040***	0.013***	0.002***	0.017***
	(0.004)	(0.005)	(0.007)	(0.001)	(0.000)	(0.002)
Cash flow-to-assets	0.043	0.027	0.042	0.047***	0.021***	0.047**
	(0.031)	(0.035)	(0.030)	(0.013)	(0.007)	(0.021)
EBITDA-to-assets	−0.391***	−0.166***	−0.389***	−0.182***	−0.055***	−0.166***
	(0.037)	(0.044)	(0.045)	(0.013)	(0.010)	(0.024)
log(Total assets)	−0.042***	−0.068***	−0.041***	−0.010***	−0.009***	−0.010***
	(0.004)	(0.009)	(0.003)	(0.001)	(0.001)	(0.001)
GDP growth	0.300	0.191	0.797**	0.024	0.024	−0.051
	(0.200)	(0.217)	(0.341)	(0.034)	(0.024)	(0.117)
log(GDP per capital)	0.049**	0.063**	0.011	0.001	0.003	0.001
	(0.022)	(0.026)	(0.020)	(0.003)	(0.003)	(0.004)
Stockmarket cap to GDP	0.054**	0.050**	0.023**	−0.002*	−0.001	0.002
	(0.021)	(0.023)	(0.010)	(0.001)	(0.001)	(0.002)
Observations	108,700	108,700	108,700	79,830	79,830	79,830
R^2	0.36	0.64	0.26	0.33	0.84	0.21
Economic significance : $\Delta E(y) \equiv E(y\|\eta = 0, .) - E(y\|\eta = 1, .)$						
ΔE(*Dependent variable*)	−0.081**	−0.102***	−0.094**	−0.005	−0.004*	−0.009***
Standard error	(0.032)	(0.035)	(0.037)	(0.003)	(0.002)	(0.003)
$\frac{\Delta E(\textit{Dependent variable})}{\text{mean } \textit{Dependent variable}}$	−0.212	−0.267	−0.246	−0.099	−0.077	−0.183

sample of countries between 2000 and 2010: the reforms of France, Italy, and Brazil in 2005. Second, we test the theory outside our sample period with a well known major change to the renegotiability of debt in the U.S.: the 1978 Bankruptcy Reform Act. The goal of these additional tests is to verify the cross-country results in a setting that, by design, reduces the concern that our results may be driven by unobserved country characteristics.

5.1. Bankruptcy code reforms in France, Italy, and Brazil

While there are a few bankruptcy law reforms during our sample period, most of these reforms do not change provisions in the bankruptcy code related to the enforcement of debt contracts. They have much broader scope and typically aim at improving the overall efficiency of the bankruptcy procedure.[14]

We are able to identify three bankruptcy code reforms in our sample of 41 countries that change debt enforcement by easing the renegotiability of debt: France, Italy, and Brazil.[15] In 2005, France added to its bankruptcy law a reorganization procedure inspired by the U.S.'s Chapter 11 ("Sauvegarde de l'entreprise"). The main change was to allow management to retain control of the distressed company, and the goal was to facilitate debt renegotiations, explicitly recognizing that creditors may benefit from transferring some value and control to managers and shareholders (Weber, 2005).

As in France, the reform in Italy in 2005 aimed at facilitating debt renegotiations while protecting debtors (see Rodano, Serrano Velarde, and Tarantino, 2016). Rodano, Serrano Velarde, and Tarantino (2016) show that the value of debt restructured in- or out-of-court significantly increased after this reform was passed. Similarly, Brazil's new bankruptcy law in 2005 was inspired by Chapters 7 and 11 of the U.S. bankruptcy code [see Alencar and Ponticelli (2016) for a detailed discussion]. The new law introduced automatic stay on all litigations against the debtor and made it easier for debtors to initiate debt renegotiation. While the overall reform was much broader, it arguably also weakened debt enforcement.

For each country, we focus on the behavior of firms from 3 years before to 3 years after each reform, that is, we use yearly observations from 2002 to 2008. Following the predictions of the model, we expect that firms with a high default probability modify their investment and risk after the reform, while firms with a low default probability do not change investment and risk. Therefore, we distinguish between firms that should be affected by the reform and firms that should not be affected by conditioning on the firm's default probability before the reform. We define the variable *High default probability*$_i$ that equals one if the firm's default probability at the end of 2002 is above the second tercile breakpoint of the country's distribution. *High default probability*$_i$ equals zero for all firms below the first tercile breakpoint of the 2002 default probability distribution.[16] In the empirical model, we can think of firms with a high default probability as firms treated by the reform, while the low default probability firms are the control firms.

To study the effects of the reforms on investment, asset growth, and risk, we estimate the following differences-in-differences specification:

$$\begin{aligned} \textit{Dependent variable}_{i,t} = {} & \alpha_i + \delta_t + \boldsymbol{\beta}_{Control} \times \mathbf{Controls}_{i,t-1} \\ & + \beta_{PD} \times \textit{POST} \\ & \times \textit{High default probability}_i + \epsilon_{i,t}. \end{aligned} \tag{8}$$

The dependent variable in Eq. (8) is *Investment, Asset growth*, or either of the risk measures. *POST* equals zero until 2004 and one thereafter, indicating that debt becomes *more easily* renegotiable. A *POST* dummy equal to one is thus consistent with a lower value of *Debt enforcement* in our previous tests. The parameter of interest is β_{PD}, which measures the average change in investment, asset growth, or risk of firms with a high default probability after the bankruptcy code reforms (the treatment group), relative to firms with a low default probability (the control group). Given that debt is easier to renegotiate after each reform, we predict that β_{PD} should be positive for investment and asset growth and negative for risk.

Since firms may not be randomly assigned to the exposure groups, we control for the same time-varying observable firm characteristics as in the main specification (6). We also include firm fixed effects (α_i) to absorb time-invariant differences across firms and year fixed effects (δ_t) to control for time-varying factors common to all firms. Finally, we cluster standard errors at the firm level because firms' investment and risk choices may be correlated over time.

Panel A of Table 7 presents the results. Columns 1 and 2 show that the coefficient estimate of *POST* $\times$ *High default probability* is statistically and economically significant. Economically, high default probability firms increase their investment rates by 1.6 to 1.7 percentage points after the reforms relative to low default probability firms. Similarly, asset growth rates of high default probability firms increase on average by 8.0 to 11.9 percentage points compared to those of low default probability firms (columns 3 and 4). Finally, columns 5–8 show that equity volatility and idiosyncratic volatility decrease after the reform for firms with a high default probability relative to those with a low default probability. In all cases, the coefficient estimates of *POST* $\times$ *High default probability*$_i$ are statistically and economically significant.[17] That is, our main

[14] Examples are the reforms undertaken in Poland between 2004 to 2007, which involved changes to improve the operations of the courts, or in Peru in 2006, which expanded the pool of assets usable as collateral.

[15] According to Djankov, McLiesh, and Shleifer (2007), Spain and Russia had bankruptcy reforms in 2004 that increased the creditor rights index by one point. As for Poland, the reforms affected many dimensions of the bankruptcy code. Hence, we exclude these two countries from the following analysis.

[16] The results are quantitatively similar if we split the sample at the median or at the first and third quartile breakpoints. The results are also similar if we only include observations from 2003 to 2007, i.e., if we perform the tests using data that start 2 years before and end 2 years after the reform.

[17] We have also performed this analysis using a continuous measure of default probability, as done in Tables 4–6. We obtain similar results.

Table 7

Bankruptcy code changes, investment, asset growth, and risk.

This table presents estimates from firm fixed effects regressions around bankruptcy code reforms in France, Italy, and Brazil (Panel A), and the US (Panel B) that facilitated debt renegotiations. The dependent variable is *Investment* in columns 1 and 2, *Asset growth* in columns 3 and 4, *Equity vol* in columns 5 and 6, and *Idiosyncratic vol* in columns 7 and 8. *POST* is a reform indicator that takes the value of one from 2005 (Panel A) or 1979 (Panel B) onward, and zero otherwise. A value of one for *POST* indicates weaker *Debt enforcement*. In Panel A, we keep the years from 2002 to 2008, and in Panel B the years from 1976 to 1982 in the sample. *High default probability*$_i$ equals one if the firm's default probability is higher than the country's second tercile breakpoint in 2002 (Panel A) or 1976 (Panel B), and zero if it is lower than the first tercile breakpoint. All specifications include year and firm fixed effects. Standard errors (in parentheses under each estimate) are clustered by firm. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Panel A: France, Italy, and Brazil bankruptcy reforms of 2005

Dependent variable:	*Investment*		*Asset growth*		*Equity vol*		*Idiosyncratic vol*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
POST × *High default probability*	0.016***	0.017***	0.080***	0.119***	−0.078***	−0.075***	−0.078***	−0.077***
	(0.004)	(0.005)	(0.023)	(0.024)	(0.027)	(0.028)	(0.027)	(0.028)
Market-to-book ratio		0.008**		0.089***		0.014		0.006
		(0.003)		(0.017)		(0.016)		(0.017)
Cash flow-to-assets		0.054**		−0.287*		−0.029		−0.096
		(0.026)		(0.153)		(0.291)		(0.299)
EBITDA-to-assets		0.018		0.453***		−0.253		−0.171
		(0.024)		(0.136)		(0.243)		(0.253)
log(Total assets)		0.014***		0.251***		−0.019		−0.031
		(0.004)		(0.030)		(0.032)		(0.034)
Firm and year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,462	2,389	2,544	2,428	2,544	2,428	2,512	2,397
R^2	0.53	0.55	0.28	0.40	0.50	0.52	0.49	0.50

Panel B: U.S. Bankruptcy Reform Act of 1978

Dependent variable:	*Investment*		*Asset growth*		*Equity vol*		*Idiosyncratic vol*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
POST × *High default probability*	0.015***	0.014***	0.035***	0.043***	−0.017***	−0.016**	−0.021***	−0.021***
	(0.003)	(0.003)	(0.008)	(0.008)	(0.007)	(0.007)	(0.006)	(0.007)
Market-to-book ratio		0.027***		0.069***		0.014**		0.009
		(0.003)		(0.013)		(0.006)		(0.006)
Cash flow-to-assets		0.142***		−0.059		−0.252***		−0.241***
		(0.038)		(0.106)		(0.065)		(0.063)
EBITDA-to-assets		0.029		0.402***		−0.110*		−0.099*
		(0.028)		(0.091)		(0.058)		(0.056)
log(Total assets)		0.035***		0.201***		−0.004		−0.020*
		(0.004)		(0.013)		(0.011)		(0.011)
Firm and year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,686	10,559	11,561	10,641	11,404	10,514	11,404	10,514
R^2	0.65	0.69	0.36	0.47	0.63	0.63	0.62	0.62

theoretical predictions are also supported for the cases in our sample where bankruptcy laws changed to increase the renegotiability of debt.

The core assumption to identify the treatment effect in a differences-in-differences regression is that, in the absence of treatment, there is no pre-existing differential trend between treated and control firms. Any difference in observed trends after treatment are assumed to arise because of treatment. Fig. 1 plots the year-by-year difference in investment, asset growth, and risk between high and low default probability firms relative to the year 2002 (event year −3). The figure shows that before the bankruptcy reforms in 2005 (event year 0), the average differences in investment, asset growth, and risk between high and low default probability firms are not statistically different from those in 2002 (year $t-3$), suggesting that trends in outcomes for treatment and control groups prior to treatment were the same, consistent with the parallel trends assumption. We only observe statistically significant differential investment rates, asset growth, and risk after the bankruptcy reform.

5.2. The US Bankruptcy Reform Act of 1978

In the U.S., the Bankruptcy Reform Act (BRA) made three major changes to Chapter 11 of the U.S. bankruptcy code, starting in October 1979 (see Hackbarth, Haselman, and Schoenherr, 2015). First, it imposed court-mandated reorganizations ('cramdowns') in case of disagreement by shareholders and creditors (White (1989); and Klee (1979)). Second, it lifted the insolvency requirement to file for a reorganization. Third, it decreased the proportion of votes needed to approve a reorganization plan. Overall, the BRA made debt renegotiations more attractive to creditors and shareholders, as the threat of voluntary Chapter 11 filing became a strategic tool for shareholders to extract

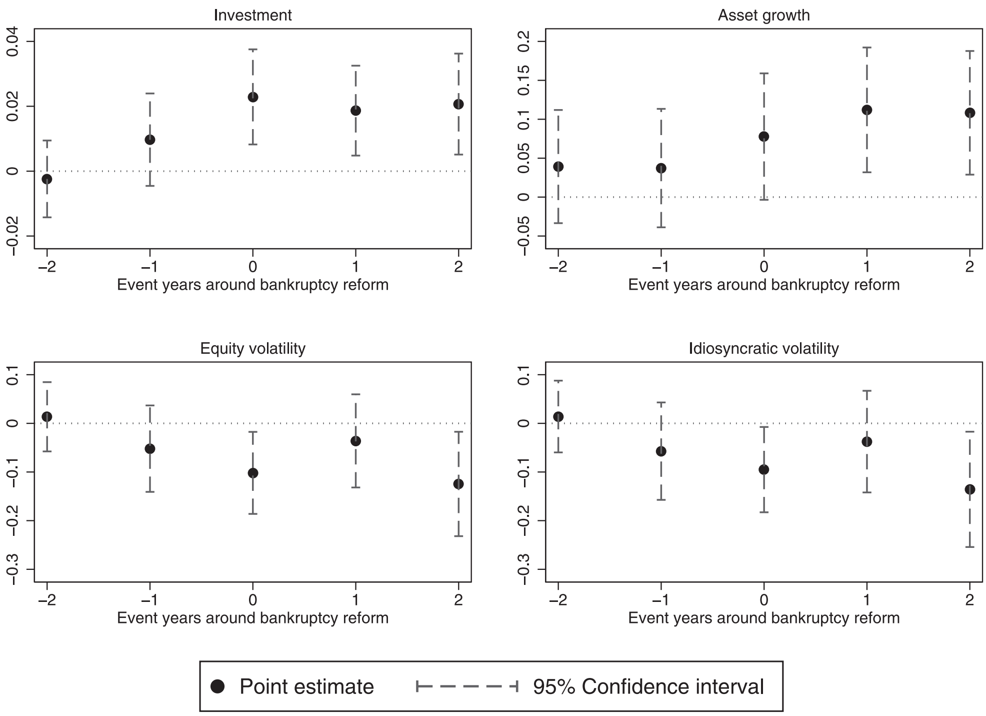

Fig. 1. Bankruptcy reforms in Italy, France, and Brazil. The graph presents the average difference in *Investment*, *Asset growth*, *Equity volatility*, and *Idiosyncratic volatility* between high and low default probability firms, conditioning on firm and year fixed effects and control variables. The sample period is from 2002 to 2008. The event year 0 corresponds to the bankruptcy reform year in 2005. The point estimates and confidence intervals refer to the coefficients of the interaction terms between the high default probability dummy and annual event-time dummies around the reforms. The point estimates are relative to the year 2002, the year in which firms are sorted in treated (high default probability) and control (low default probability) groups.

rents from creditors. As a result, shareholders of financially distressed firms achieved higher concessions from creditors in out-of-court restructurings (Franks and Torous, 1994), as well as higher deviations from the Absolute Priority Rule in Chapter 11 (see Franks and Torous, 1989; Eberhart, Moore, and Roenfeldt, 1990). Further, equity returns decreased because of a lower required distress premium (Hackbarth, Haselman, and Schoenherr, 2015).

The BRA is also well suited to test our hypotheses because it was designed to encourage debt renegotiation and shifted the bargaining power in reorganizations toward shareholders. Moreover, this well known reform allows us to validate our main results in a different sample period, while keeping the other institutional characteristics constant.

We conduct a differences-in-differences analysis around the BRA as for the reforms in France, Italy, and Brazil. We include in the analysis 3 years before and three years after the reform year 1979, i.e., the years from 1976 to 1982. All variables are defined and computed as in the cross-country analysis, except that we use Compustat data because Worldscope's coverage starts only in 1990. The reform indicator *POST* equals zero until 1978 and one thereafter indicating *easier* renegotiability of debt. *High default probability*$_i$ equals one if the firm's default probability at the end of 1976 is above the second tercile breakpoint of the 1976 (pre-reform) distribution, and zero if it is below the first tercile breakpoint.

As shown in Panel B of Table 7, investment and asset growth increase while risk decreases post-BRA for firms with a high default probability relative to firms with a low default probability. All coefficients are statistically and economically significant. We obtain similar results when using a continuous measure of default probability, as in Tables 4–6.

As done for the reforms in France, Italy, and Brazil, Fig. 2 plots the year-by-year difference in investment, asset growth, and risk between high and low default probability firms for the BRA relative to the year 1976. The figure shows that high and low default probability firms have similar changes in investment rates, asset growth, and risk before the BRA, and that these changes only start diverging post-BRA.

6. Robustness analysis

6.1. Ex ante creditor rights and debt enforcement

A large empirical literature, surveyed by La Porta, Lopez-de Silanes, and Shleifer (2008), studies the effects of creditor protection on corporate investment and financing policies. Most papers in this literature measure the variation in creditor protection across countries with the creditor rights index of La Porta, Lopez-de Silanes, Shleifer, and Vishny (LLSV, 1998). The LLSV index varies from 0 (weakest) to 4 (strongest) and aggregates four binary indicators of the power of creditors in bankruptcy to (i) approve a

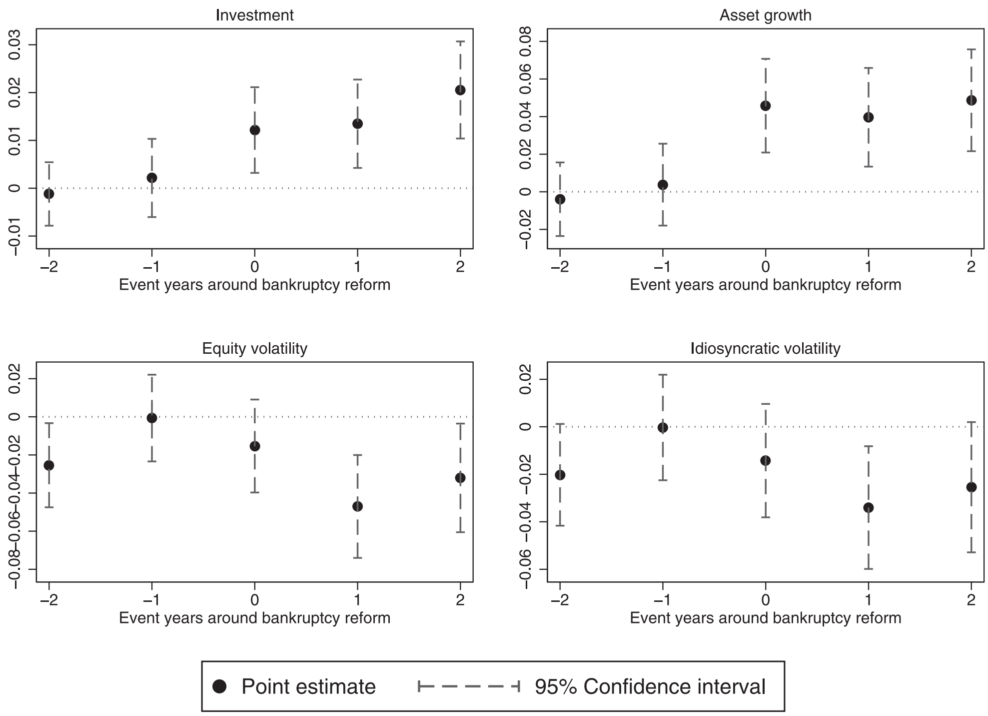

Fig. 2. U.S. Bankruptcy Reform Act. The graph presents the average difference in *Investment, Asset growth, Equity volatility*, and *Idiosyncratic volatility* between high and low default probability firms, conditioning on firm and year fixed effects and control variables. The sample period is from 1976 to 1982. The event year 0 corresponds to the bankruptcy reform year in 1979. The point estimates and confidence intervals refer to the coefficients of the interaction terms between the high default probability dummy and annual event-time dummies around the reforms. The point estimates are relative to the year 1976, the year in which firms are sorted in treated (high default probability) and control (low default probability) groups.

debtor's filing for reorganization; (ii) seize collateral after a reorganization petition is approved; (iii) be paid first out of the liquidation proceeds; and (iv) replace the incumbent manager during the reorganization.

The *Debt enforcement* index used in our empirical analysis differs from the LLSV index because it builds on the detailed narratives provided by law practitioners in the DHMS survey about the debt enforcement procedure that is *actually* used in each country. As such, our index suffers less from the common criticism to the LLSV index, that the strength of creditor rights in bankruptcy is best measured by how the law is expected to be enforced in practice, as opposed to how it is written on the books.

For example, with reference to the measurement of creditor rights in India, Vig (2013) writes "Although India ranks quite high in terms of the LLSV creditor rights index and attains a maximum score of 4, the enforcement of creditor rights has been seen as a major impediment to lending in India. Historically, the judicial process was extremely rigid, marked by bureaucratic delays, and it took a long time before creditors could access collateral." In our sample of countries, the correlation between the *Debt enforcement* index and the LLSV index is about 0.40. Belgium, Canada, Switzerland, Finland, Hungary, Ireland, Japan, Peru, Philippines, Portugal, Sweden, Thailand, Turkey, Taiwan, and USA have a debt enforcement index above the sample median and a LLSV index below the sample median. In contrast, Germany, Denmark, Korea, the Netherlands, and South Africa have a debt enforcement index below the sample median, and a LLSV index above the sample median.

To test our claim that what matters for investment and risk choices is debt enforcement in default, Table 8 reports the estimates of our benchmark investment, asset growth, and risk regressions using the LLSV index of creditor rights instead of our index of *Debt enforcement*. If our results were driven by cross-country differences in the ex ante protection of creditor rights, rather that frictions in the enforceability of debt contracts in default, we would expect the interaction between *Default probability* and the LLSV creditor rights index (*Creditor rights*) to be correlated with the firms' investment and risk variables across countries.

Columns 1–4 of Table 8 show that this is not the case: controlling for country and industry fixed effects, firms' investment and risk are significantly related to firms' default probability. However, the interaction of *Default probability* with *Creditor rights* is never statistically significant, suggesting that the relation between investment or risk and the default probability is not significantly related to cross-country differences in the LLSV index of ex ante protection of creditor rights. The results reported in these columns are robust to using alternative fixed effects estimators.

6.2. Extended debt enforcement index

Our tests so far use a measure of debt enforcement based on the 16 characteristics out of 24 reported in the

Table 8
Robustness analysis: Creditor rights, investment, and risk.
The table presents industry and country fixed effects estimates of investment, asset growth, and risk regressions. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). All columns include *Market-to-book ratio, Cash flow-to-capital, EBITDA-to-assets*, log(*Total assets*), *GDP growth*, log(*GDP per capita*), and *Stock-market cap to GDP* as control variables, as well as year fixed effects. Columns 1 and 2 compare the conditional correlations between *Creditor rights* and *Investment* and *Asset growth*, respectively. Columns 3 and 4 compare the conditional correlations between *Creditor rights* and risk. The coefficient on *Default probability* reports the conditional correlation between the dependent variable and *Default probability* evaluated at the sample mean of *Creditor rights*. Standard errors (in parentheses under each estimate) are clustered by country. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Dependent variable	*Investment* (1)	*Asset growth* (2)	*Equity vol* (3)	*Idiosyncratic vol* (4)
Default probability (DP)	−0.003**	−0.036***	0.219***	0.207***
	(0.002)	(0.014)	(0.023)	(0.022)
DP × *Creditor rights (CR)*	0.001	−0.001	0.012	0.016
	(0.001)	(0.009)	(0.013)	(0.016)
Observations	102,239	103,028	108,700	105,111
R^2	0.25	0.15	0.39	0.38
Economic significance : $\Delta E(y) \equiv E(y\|CR=0,.) - E(y\|CR=4,.)$				
ΔE(*Dependent variable*)	−0.002	0.024	−0.041	−0.055
Standard error	(0.004)	(0.037)	(0.045)	(0.037)
$\frac{\Delta E(\textit{Dependent variable})}{\text{mean } \textit{Dependent variable}}$	−0.039	0.624	−0.065	−0.097

DHMS survey that, according to Favara, Schroth, and Valta (2012), are clear indicators of whether debt can be successfully renegotiated. In this section, we test the robustness of our results to using an extended debt enforcement index that also includes the remaining eight characteristics from the DHMS survey. As with the original *Debt enforcement* index, each additional binary indicator in the extended index takes a value of one if it strengthens debt enforcement. Appendix B.2 describes these variables and the extended index in detail.

Columns 1–4 of Table 9 show the estimates of our benchmark investment and risk regressions when using the extended debt enforcement index. We obtain the same qualitative results as before, if quantitatively stronger.

6.3. Other robustness checks

Columns 5–8 of Table 9 show the estimates of our benchmark investment and risk regressions using a subsample that excludes U.S. and Japanese firms. The results are not affected by the exclusion of such firms, even though they account for almost 30% of the firms in the sample.

In additional unreported tests we replace the firm's *Default probability* measure, which is Bharath and Shumway's (2008) approximation of the Merton distance-to-default model, with the Altman's *Z*-score. We obtain similar results.

7. Conclusion

We argue that the prospect of an imperfect enforcement of debt contracts in default reduces shareholder–debtholder conflicts and induces leveraged firms to invest more and take on less risk as they approach financial distress. To test these predictions, we use a large panel of firms from 41 countries with heterogeneous debt enforcement characteristics. We find that debt renegotiation frictions that strengthen the enforcement of debt contracts relate to investment and firm risk through their interactions with the firm-specific probability of default. The results suggest that the possibility of an imperfect enforcement of debt contracts, which likely increases shareholders' expected recovery in default, decreases the underinvestment and asset substitution distortions caused by agency conflicts near insolvency.

Previous literature has found that some forms of strengthening of creditor rights may lead to smaller debt overhang distortions near default. Our study shows that these distortions may also be mitigated by a *weakening* of the enforceability of debt contracts in default. There are two take-aways from our analysis. First, the policy choices of firms near default depend on the different ways creditor rights may be enforced in practice. Second, the relative benefits and costs of pro-creditor and pro-debtor approaches to bankruptcy regulation, and their effects on investment policy, should be studied in future research.

Appendix A. Data set

We start with all the countries in the DHMS survey that are also covered by Worldscope, Capital IQ, and Datastream. For every firm in each country, we download annual accounting variables, in USD, from Worldscope, and weekly and daily price data, in USD, from Datastream. For U.S. firms, we download price data from CRSP. We match the firm-level data with several country-specific institutional variables that come from the World Bank. We drop some countries because of the low number of observations (Colombia, Czech Republic, Egypt, and Venezuela), and because the institutional variables are not available (India,

Table 9
Robustness analysis: Extended debt enforcement index and alternative subsamples.
The table presents industry and country fixed effects estimates of investment, asset growth, and risk regressions. The sample contains firm-year observations from the Worldscope and Capital IQ databases between 2000 and 2010 that could be matched to the countries surveyed by Djankov, Hart, McLiesh, and Shleifer (2008). All columns include *Market-to-book ratio, Cash flow-to-capital, EBITDA-to-assets*, log(*Total assets*), *GDP growth*, log(*GDP per capita*), and *Stockmarket cap to GDP* as control variables, as well as year fixed effects. Columns 1–4 present the estimates using an extended index of debt enforcement, *Debt enforcement (extended)*. Columns 5–8 present the estimates from the subsample excluding all firms in the U.S. and Japan. The coefficient on *Default probability* reports the conditional correlation between the dependent variable and *Default probability* evaluated at the sample mean of the extended *Debt enforcement* index. Standard errors (in parentheses under each estimate) are clustered by country. Estimates followed by the symbols ***, **, or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	Extended debt enforcement index				Subsample excluding U.S. and Japan			
Dependent variable	*Investment* (1)	*Asset growth* (2)	*Equity vol* (3)	*Idiosyncratic vol* (4)	*Investment* (5)	*Asset growth* (6)	*Equity vol* (7)	*Idiosyncratic vol* (8)
Default probability (DP)	−0.004**	−0.036**	0.220***	0.208***	−0.006***	−0.055***	0.244***	0.229***
	(0.002)	(0.014)	(0.021)	(0.019)	(0.001)	(0.011)	(0.019)	(0.019)
DP × Debt enforcement (extended index)	−0.015*	−0.108**	0.307**	0.297**				
	(0.008)	(0.044)	(0.129)	(0.131)				
DP × Debt enforcement					−0.007*	−0.049**	0.206***	0.211***
					(0.004)	(0.022)	(0.074)	(0.074)
Observations	102,239	103,028	108,700	105,111	67,085	67,780	71,995	69,928
R^2	0.25	0.15	0.39	0.38	0.21	0.16	0.38	0.38
Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$								
ΔE(*Dependent variable*)	0.013*	0.093**	−0.263**	−0.254**	0.006*	0.042**	−0.174***	−0.179***
Standard error	(0.007)	(0.038)	(0.109)	(0.11)	(0.003)	(0.019)	(0.062)	(0.062)
$\frac{\Delta E(\textit{Dependent variable})}{\text{mean } \textit{Dependent variable}}$	0.295	1.886	−0.552	−0.567	0.145	0.830	−0.365	−0.397

Pakistan, and Zimbabwe). We also drop firm-years with negative or zero total assets or sales, and firm-years for which the (absolute value of) negative EBITDA is larger than total assets, as in Bris, Koskinen, and Nilsson (2009). The results do not depend on this exclusion because it involves very few firm-years. We end up with a sample of firms from 41 countries, including all Organisation for Economic Co-operation and Development (OECD), some Latin American, Middle Eastern, and Asian countries. Our panel is unbalanced because we do not require that the firms exist for the whole sample period.

Appendix B. Debt enforcement index

B.1. Baseline debt enforcement index

The construction of the *Debt enforcement* index follows the paper by Favara, Schroth, and Valta (2012) and is based on the DHMS survey data. The individual data items are available on Andrei Shleifer's web page. The index measures the degree of enforcement of debt contracts in default and is based on 16 individual indicators. The measure of debt enforcement in the model is a continuous measure that takes values between zero and one. Accordingly, the *Debt enforcement* index is the average of the following non-missing binary (zero if no, one if yes) indicators where the variable names in parentheses correspond to the names in the DHMS data set (when a variable X decreases debt enforcement, we take $1-X$):

1. Out of court seizure and sale: Secured creditors may seize and sell their collateral without court approval (ooc);
2. No judge for enforcement: Secured creditors may enforce their security either in or out of court (sumjud);
3. Floating charge: The entire business's assets can be pledged as collateral (floating);
4. Case proceeds on appeal of insolvency: An insolvency order cannot be appealed at all (apporde);
5. Case proceeds on appeal of liquidation: A liquidation order cannot be appealed at all (appsal);
6. Case proceeds on claim amount dispute: An insolvency case is suspended until the resolution of the appeal (1-disclai);
7. Reorganization attempt required: The firm may enter liquidation without attempting reorganization (1-attemreo);
8. Automatic trigger for liquidation: An automatic trigger mechanism can initiate insolvency (trigliq);
9. Automatic stay on enforcement: Secured creditors may enforce their security upon commencement of the insolvency proceedings (1-scsstay);
10. Automatic stay on lawsuits: Secured creditors may enforce their security in lawsuits (1-lawsc);
11. Firm must cease operating: A defaulting firm must cease operations upon commencement of insolvency proceedings (opceas);
12. Management remains: Management does not remain in control of decisions during insolvency proceedings (1-mancont);
13. Creditor approves administrator: Secured creditors have the right to approve the appointment of the insolvency administrator (whoapp);
14. Creditor dismisses administrator: Secured creditors may dismiss the insolvency administrator (dismiss);
15. Creditor vote directly: Secured creditors vote directly on the reorganization plan (scvotdir);

16. Proof of reorganization prospects: Firm must submit proof of reorganization prospects before reorganization proceedings may commence (proofreo).

B.2. Additional characteristics from the DHMS survey and extended index

Our baseline *Debt enforcement* index is based on 16 individual indicators, out of 24 indicators reported by DHMS. This baseline index does not include all 24 indicators, as for eight of them it was not clear to us whether they made debt enforcement in default easier or more difficult. In a robustness test, we use an extended debt enforcement index that also includes the following (remaining) characteristics from the DHMS survey, in addition to the 16 individual indicators of our baseline *Debt enforcement* index.

1. Statutory time limits on appeals: Time limits on appeals are probably good for creditors to enforce their claim (apptime);
2. Restrictions on dismissals: The firm is not restricted from dismissing employees upon initiation of insolvency proceedings (empres);
3. Contracts may be rescinded: Suppliers and customers may rescind contracts without penalty upon initiation of insolvency proceedings (supresc);
4. Specialized court: The authority with jurisdiction is either a specialized bankruptcy court or a specialized bankruptcy administrative authority (spec);
5. Administrator paid on market value: The insolvency administrator is remunerated based on the market value of the insolvency estate (mktval);
6. Same judge for claim amount dispute: An appeal of the amount of the claim is handled by the same judge supervising the insolvency case (disju);
7. Same judge for appeal of insolvency: An appeal of the initiation of the insolvency case is handled by the same judge supervising the insolvency case (orderju);
8. Same judge for appeal of liquidation: An appeal of the order to liquidate is handled by the same judge supervising the insolvency case (saleju).

Some of these variables are difficult to classify as pro-debtor or pro-creditor, for example, those related to judges. Results are similar if we exclude the last three indicators from the list above.

Appendix C. Debt enforcement and risk taking without investment

Suppose now that there is no investment opportunity but that shareholders can increase risk after debt has been issued. In this case, equity value is given by

$$E(V_0;\underline{D}) = p^2(z^2V_0 - \underline{D}) + 2p(1-p)(V_0 - \underline{D}) + (1-p)^2(1-\eta)z^{-2}V_0.$$

Using the definition of the risk-neutral probability of an increase in asset value, we have that:

$$\frac{\partial E(V_0;\underline{D})}{\partial z} = \frac{2[\underline{D}z + \eta V_0]}{(1+z)^3} > 0, \qquad \text{(C.1)}$$

in the low leverage case so that:

$$\frac{\partial^2 E(V_0;\underline{D})}{\partial z \partial \eta} = \frac{2V_0}{(1+z)^3} > 0. \qquad \text{(C.2)}$$

Simple calculations also show that we have

$$\frac{\partial^2 E(V_0;\overline{D})}{\partial z \partial \eta} = \frac{2zV_0}{(1+z)^3} > 0,$$

in the high leverage case so that

$$\frac{\frac{\partial^2 E(V_0;\overline{D})}{\partial z \partial \eta}}{\frac{\partial^2 E(V_0;\underline{D})}{\partial z \partial \eta}} = \frac{\frac{2zV_0}{(1+z)^3}}{\frac{2V_0}{(1+z)^3}} = z > 1.$$

As in the case with investment, debt enforcement has a greater effect on risk-shifting incentives when default risk is larger.

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